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The Impact of Procedural Sedation on Diagnostic Errors in Pediatric Echocardiography

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Abstract

Background—Infants and young children frequently have difficulty remaining still for an echocardiogram, potentially leading to poor study quality, increasing the likelihood of diagnostic errors. Sedation is believed to improve echocardiography quality; however, its effectiveness has not been demonstrated. We hypothesized that sedation would improve study quality and reduce diagnostic errors.

Methods—We examined outpatient echocardiograms in children 36 months from January 2008 – June 2009. We collected variables related to image quality, report completeness and sedation use. Diagnostic errors were identified and categorized. Multivariable analysis identified the odds ratio (OR) and 95% confidence interval (CI) for risk factors for potentially preventable diagnostic errors and the impact of sedation on these errors.

Results—Among 2,003 echocardiograms, sedation was used in 498 (25%). The overall diagnostic error rate was 6.5%. Most errors (66%) were potentially preventable. Multivariable analysis identified the following risk factors for potentially preventable errors: pre-cardiac procedure (OR 2.19, 95% CI 1.05 to 4.59, P=0.04); moderate anatomic complexity (OR 3.91, 95% CI 2.25 to 6.81, P<0.001); and high anatomic complexity (OR 8.36; 95% CI 3.57 to 19.6, P<0.001). Sedation was independently associated with lower odds for potentially preventable diagnostic error (OR 0.47, 95% CI 0.27 to 0.80, P=0.006). Echocardiograms with sedation had fewer image quality concerns (22% vs. 60%) and fewer incomplete reports (3% vs. 20%) (P<0.001).

Conclusions—Most echocardiographic diagnostic errors among infants and young children are potentially preventable. Sedation is associated with a lower likelihood of these diagnostic errors, fewer imaging quality concerns, and fewer incomplete reports.

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Heart defects are among the more common types of congenital malformations in infants and remain a leading cause of death.¹ Echocardiography is the primary imaging modality used to evaluate infants and young children for heart disease.² Often, infants and young children cannot lie still during an echocardiogram, which may lead to incomplete examinations, suboptimal image quality, and diagnostic errors.³ Delayed or inaccurate diagnoses may place children with heart disease at risk for adverse outcomes.⁴ Procedural sedation is believed to improve echocardiographic study quality. Although the safety of various procedural sedation strategies for echocardiography has been extensively studied and reported, their impact on image quality and diagnostic error has not been systematically examined.^{5–8} As a result, there is little data to inform pediatric and congenital cardiologists if there is an actual impact of sedation on echocardiography image quality or diagnostic accuracy.^{9–11} In this study we sought to examine the effect of sedation on diagnostic errors, the frequency of incomplete examinations, and the frequency of image quality concerns in infants and young children presenting for outpatient echocardiography.

METHODS

The Scientific Review Committee of the Department of Cardiology and the Institutional Review Board at Boston Children's Hospital approved this study.

Study Setting—This study was performed in infants and young children undergoing outpatient echocardiography in a large academic pediatric and congenital echocardiography laboratory that performs approximately 22,000 echocardiograms annually. Trained pediatric sonographers, pediatric cardiology fellows, and pediatric echocardiography staff cardiologists performed the studies, which were electronically stored. The pediatric echocardiography staff cardiologists interpreted all studies and issued a report, which is part of the patient's electronic medical record.

Case selection—We examined outpatient echocardiograms performed with and without sedation in infants and young children aged < 36 months from January 1, 2008 through June 30, 2009. Only one echocardiogram was included per patient. For patients with multiple studies during this time period, only the first examination was included, whether it occurred with or without sedation. The study period was selected to allow at least 3 years between performance of the examination and our review. This time interval was chosen to increase the likelihood of discovery of any diagnostic error through subsequent investigations or procedures.

Echocardiography sedation methods—The patient's primary cardiologist decided whether to request an echocardiogram under sedation. A patient was considered eligible for outpatient nursing sedation if age < 36 months and without significant airway obstruction, lung disease, or severe cyanosis (oxygen saturations < 70% in room air). Patients not fulfilling these criteria or having other morbidities (e.g., severe pulmonary hypertension) were referred for sedation by the cardiac anesthesia service. As long as patients sedated by the cardiac anesthesia service were able to undergo their procedure on an outpatient basis, they were included in this study. Patients referred for echocardiograms under sedation were

screened by the pediatric cardiac nursing staff and were examined by the prescribing attending echocardiographer. Nursing sedation consisted of a single oral dose of chloral hydrate (typical dose 80 mg/kg up to 1 gram) according to institutional guidelines. Vital signs, including heart rate, blood pressure, respiratory rate, and pulse oximetry, were recorded throughout the procedure. As of April 2014, these sedation procedures have not changed substantially.

Outcome Variables

Diagnostic error—A diagnostic error was defined as a diagnosis that is unintentionally delayed, wrong, or missed as judged from eventual appreciation of the existing data or more definitive information.³ Diagnostic errors were identified by examining the echocardiogram reports for discrepancy when compared to diagnostic findings from all other sources (e.g., cardiac catheterization, magnetic resonance imaging, operative observations, subsequent echocardiographic examinations, outpatient clinic records and autopsy when available).

Diagnostic error categorization—Following identification of diagnostic errors, the primary echocardiographic images were reviewed in order to confirm errors and categorize them according to type, preventability, severity and contributing factors, according to previously published methods.³ For cases without diagnostic error, only reports, and not primary image data, were reviewed. Errors were categorized as false negatives, false positives, or discrepant diagnoses. Error severity was categorized as minor (no effect on patient management), moderate (impact on patient management, may place patient at risk for adverse event), major (contributes to adverse event), or catastrophic (contributes to patient death). Contributing factors to error included the following categories: procedural/conditional, cognitive, technical, or patient/disease-related. The specific anatomy involved in the error was also recorded. All diagnostic errors and relevant images were reviewed and either confirmed or excluded by a second investigator (OJB) who adjudicated the error type, severity, preventability and contributing factors.

Potentially preventable diagnostic error—Our focus was to examine diagnostic errors that were potentially preventable (Table 1). Potentially preventable errors are errors where echocardiography is considered the correct imaging modality to establish the diagnosis, which could have been made by a more complete examination or different imaging technique (e.g. the use of continuous wave Doppler with proper alignment). We focused on potentially preventable errors as they represent diagnostic errors that might lend themselves to quality improvement actions, such as the administration of procedural sedation. Potentially preventable errors also represent the largest fraction of diagnostic errors.³

The other categories of preventability include preventable and non-preventable diagnostic errors. Non-preventable diagnostic errors are those in which echocardiography is the incorrect imaging modality and could not be expected to establish the correct anatomic diagnosis. Preventable diagnostic errors are errors where the true diagnosis is readily apparent on study images but the diagnosis is not made (e.g., a clear demonstration of a large pericardial effusion; however a diagnosis of “no pericardial effusion” is made).

Echocardiography quality concerns and incomplete reports—An additional imaging outcome measure was the notation on the echocardiogram report of a concern about suboptimal image quality or inadequate data (e.g., “atrial septum not well imaged”; “incomplete color Doppler interrogation of the ventricular septum”). Another secondary outcome was the presence of an incomplete echocardiogram report. In our laboratory, an incomplete report is generated if a study yields few images, or if the image quality is such that the study questions could not be reliably answered. The goal in our laboratory is to provide a complete report for all outpatient echocardiographic examinations.

Predictor variables

The following demographic, clinical, and situational variables were recorded: sex, age, weight, height, presence of congenital heart disease, anatomic complexity, anatomic frequency, study location and use of sedation.

Anatomic complexity was defined as follows: (1) low (no significant heart disease or a single, simple anomaly, e.g., atrial septal defect or single ventricular septal defect); (2) moderate (anomalies involving multiple lesions or diagnoses with common constellations of combined defects, e.g., complete common atrioventricular canal, tetralogy of Fallot, hypoplastic left heart syndrome); and (3) high (uncommon variants of moderately complex lesions or rare, complex anomalies, e.g., dextrocardia, superior-inferior ventricles with criss-cross atrioventricular relations). Anatomic frequency was defined as follows, based on the incidence observed in our echocardiography laboratory: (1) frequent (diagnosis is observed more than once per week, e.g., patent ductus arteriosus); (2) less frequent (diagnosis is observed more than once a month but less than once weekly, e.g., coarctation of the aorta); (3) rare (diagnosis is observed more than once per year but less than once monthly, e.g., inferior type sinus venosus defect); and (4) very rare (diagnosis is observed less than once yearly, e.g., aortic-left ventricular tunnel).³

Study locations included the following: Main clinic (central echocardiography laboratory), satellite clinic (outreach clinics at community sites), recovery room (sedation room where examinations supervised by cardiac anesthesia are typically performed), and pre-cardiac procedure. In our institution “Pre-cardiac procedure” is recorded as the study location when the study is performed with the purpose of being the final echocardiographic assessment prior to a planned cardiac catheterization or operation, regardless of the physical location where the study is performed.

Statistical analysis

Within the study population, we performed a univariate analysis to compare patient characteristics between the group who underwent procedural sedation to those who did not using Fisher's exact test. We then compared the above variables between those with the primary outcome of a potentially preventable diagnostic error and those without such error. Variables with $P < 0.2$ in univariate analysis were included in a multivariable logistic regression model to predict odds for having a potentially preventable diagnostic error; a P value < 0.10 was required for retention in the final model. Odds ratios (OR) for having these diagnostic errors with 95% confidence intervals (CI) were calculated. Procedural sedation

was then added to the model; the logistic regression model allowed us to estimate the adjusted effect of procedural sedation on odds for having a potentially preventable diagnostic error while controlling for other risk factors.

RESULTS

A total of 2,003 patients were included. The median age at echocardiography was 9.5 months (interquartile range 2.3, 22.1). Most (55%) of the study population had congenital heart disease. Among the 2,003 patients, 498 (25%) received procedural sedation (Table 2).

Comparison of echocardiograms with and without sedation

As shown in Table 2, only 22% of the sedated patients were < 6 months as compared with 48% of the non-sedated group ($P<0.001$). The largest percentage (41%) of echocardiograms with sedation was performed in patients between the ages of 12 and 24 months. With respect to patient weight, only 9% of sedated patients were less than 5 kg as compared with 31% of non-sedated patients ($P<0.001$). Patients who underwent sedation were more likely to have congenital heart disease than the non-sedated group (75% vs. 49%, $P<0.001$) and were more likely to have moderate or high anatomic complexity (Figure). Anatomic diagnoses in sedated patients were also less commonly seen as compared with the non-sedated group.

All diagnostic errors

We identified a total of 131 diagnostic errors, for a diagnostic error rate of 6.5% in this cohort. Among these diagnostic errors, 78 (60%) were false negative, 17 (13%) were false positive, and 36 (27%) were discrepant diagnoses. The most common primary contributors to diagnostic errors were incomplete examination of an anatomic structure (37%), under-appreciation of a finding (17%), and poor imaging conditions (11%). In terms of categories of contributors to error, procedural/conditional factors were cited in 49%, cognitive errors in 30%, and technical or patient/disease-related factors in 21%. Regarding severity, 41% were of moderate severity or greater, and the severity distribution was not significantly different in the sedated vs. non-sedated groups.

Diagnostic error preventability

Among 131 diagnostic error cases, 13 (10%) were not preventable and 32 (24%) were preventable. Potentially preventable errors represented the largest percentage (66%) of all diagnostic errors.

Potentially preventable diagnostic errors

Most of the 86 potentially preventable errors were false negative (69%). This was followed by discrepant diagnoses (22%) and false positive (9%) errors. Among the potentially preventable diagnostic errors, 40% were of moderate or greater severity. The largest contributor (65%) to potentially preventable diagnostic errors was related to procedural factors or study conditions (e.g., incomplete anatomic examination or difficult imaging conditions due to patient motion). This is in contrast to non-potentially preventable diagnostic errors where cognitive errors (e.g., errors committed at the time of study interpretation) were the largest contributor (56%, $P<0.001$). Common anatomic segments

involved were the atrial septum (27%), ventricles/ventricular septum (19%), patent ductus arteriosus (9%), pulmonary veins (8%), aortic arch (7%), and coronary arteries (6%).

Comparison of potentially preventable error cases to cases without such error

The findings of the univariate analysis focusing on potentially preventable errors are summarized in Table 3. Compared to cases without a potentially preventable error, cases with such error were more likely to occur in patients with structural heart disease, moderate and high anatomic complexity, and with rare anatomic diagnoses. We also found that pre-cardiac procedure patients had higher unadjusted rates for potentially preventable diagnostic error.

Risk factors for potentially preventable errors and the effect of sedation

Multivariable analysis identified the following independent risk factors for potentially preventable diagnostic error: patients evaluated prior to a cardiac procedure (OR 2.19, 95% CI 1.05 to 4.59, $P=0.04$); moderate anatomic complexity (OR 3.91, 95% CI 2.25 to 6.81, $P<0.001$); and high anatomic complexity (OR 8.36, 95% CI 3.57 to 19.6, $P<0.001$). The presence of heart disease of any complexity level did not reach statistical significance (OR 1.86, 95% CI 0.98 to 3.54, $P=0.06$). While including these risk factors in the multivariable model, sedation was independently associated with lower odds for potentially preventable diagnostic errors (odds ratio 0.47, 95% CI 0.27 to 0.80, $P=0.006$) (Table 4).

Imaging quality concerns and incomplete echocardiography reports

We found that cardiologists were less likely to report quality concerns for echocardiograms with sedation (22% vs. 60%, $P<0.001$). Additionally, we found that echocardiograms with sedation were also less likely to result in an incomplete report (3% vs. 20%, $P<0.001$).

DISCUSSION

Diagnostic errors have been reported to be responsible for adverse events, result in greater harm than medication errors and are a leading cause of litigation.^{3, 4, 12–14}

Echocardiography is a diagnostically complex tool and is at times performed under adverse conditions that further increase the difficulty in diagnosis. Infants and young children often cannot remain still for an echocardiogram, which leads to incomplete examinations and increases the likelihood of potentially preventable diagnostic errors. To the best of our knowledge this is the first study to report that echocardiography with sedation is associated with fewer potentially preventable diagnostic errors and may be an important strategy to reduce these errors among infants and young children with heart disease.

Use of sedation in pediatric/congenital patients—The majority of outpatient sedations in our study (66%) were performed in patients between the ages of 6 and 24 months whereas only 25% of non-sedated patients fell within this age range. This observation reflects the practice pattern of the patients' cardiologists who were more likely to refer for echocardiography under sedation during late infancy and the early toddler years. This practice pattern likely reflects the perception that children at this age can be particularly

difficult to image without sedation whereas very young infants can be pacified with bottle feeding and natural sleep.

We found that infants and young children with less commonly seen heart disease and heart disease of greater anatomic complexity were more likely to be referred for echocardiography with sedation. A prior study has shown that lower body weight, younger infants and children, less common cardiac diagnoses, and greater anatomic complexity were associated with higher likelihood for diagnostic error.¹⁵ This indicates that children selected for sedation had greater diagnostic case complexity compared to their non-sedated counterparts and were at greater risk for diagnostic error. This difference in referral pattern suggests the referring cardiologists use sedation as a strategy to improve diagnostic accuracy among complex patients. This is the first study to support this notion and to demonstrate efficacy of this strategy to reduce diagnostic error. Other pediatric heart programs seeking to adopt sedation as a strategy may consider a given patient's anatomic complexity or other reported diagnostic error risk factors when considering institutional guidelines for echocardiograms under sedation.³

Contributors to diagnostic errors—In this cohort we found that the rate of diagnostic error was 6.5%. This finding is similar to a study of low birth weight infants where a diagnostic error rate was between 5.2% and 8%.¹⁵ In our study we found that a major contributor to diagnostic errors among these children was related to incomplete examinations or poor imaging conditions and that the majority of diagnostic errors were potentially preventable. The importance of incomplete examinations is consistent with our finding that most of these errors were false negative – errors in which a diagnosis was not made. That is to say that it is difficult to establish a diagnosis of an anatomic segment that was incompletely examined. This finding is important for pediatric heart centers when considering quality improvement targets to reduce diagnostic error in children. Our findings suggest that allowance for a complete examination or improved study conditions (e.g., procedural sedation) may reduce these types of errors.

An unexpected finding was the higher odds for diagnostic error in patients undergoing assessment prior to a cardiac procedure. A potential explanation for this result is that these patients are subjected to higher scrutiny around the time of a procedure in the form of alternative imaging modalities and intraoperative inspection. This could make diagnostic errors more likely to be discovered in this subgroup.

We also noted a relatively high rate of patients without structural cardiac anomalies undergoing outpatient echocardiography (45%). This is likely due to our study design's consecutive sampling strategy, as a substantial portion of infants and toddlers presenting for outpatient echocardiography will end up having no significant heart disease (e.g., referrals for murmurs and family history of heart disease). It is worth noting that while the presence of heart disease itself did not reach significance as a risk factor for potentially preventable diagnostic error, moderate and high complexity lesions did.

Impact of sedation on diagnostic errors and echocardiography quality—In this cohort, sedation was associated with a greater than 50% reduction in odds for potentially

preventable diagnostic errors. We also found that studies performed with sedation were associated with significantly fewer reports with concerns about image quality. This finding is intuitive as studies under sedation were less likely to be hampered by excessive patient motion. Similarly, studies under sedation were much less likely to result in incomplete echocardiography reports. These findings are internally consistent and point to use of procedural sedation as an effective strategy to improve echocardiography quality among infants and young children.

Considerations for sedation—While this study examined the use of sedation as a means to improve imaging quality, the specific medication used for sedation was not a focus of this investigation. Here we will review the safety profiles of the more commonly used sedative agents in pediatric echocardiography, as the decision to sedate any child involves weighing the risks of sedation against the benefits of reduced diagnostic error and improved study quality. One large series of children receiving chloral hydrate (now out of production¹⁶) reported an adverse event rate of 10.8%, the vast majority of which were desaturation or hypercarbia. Major interventions were required in 0.5% of patients, and there was no permanent morbidity.⁵ However, as the production of chloral hydrate has been discontinued, the safety profiles of other sedative agents are important to consider. With oral pentobarbital, the adverse event rate reported in one large series was 0.5%, and events were predominantly minor in severity.¹⁷ A report on minimal sedation with intranasal midazolam reported no significant adverse events.⁶ In a comparison of chloral hydrate and inhaled anesthesia (predominantly sevoflurane), adverse events occurred in 1.4% of those receiving inhaled anesthesia, and 6% of those receiving chloral hydrate (all of which were inability to complete the examination due to patient non-cooperation).¹⁸ Taken together, these data suggest that minor adverse events are infrequent, but not uncommon, and significant adverse events are rare among patients undergoing procedural sedation for echocardiography.

When weighing the advantages and disadvantages of procedural sedation for echocardiography it is important to consider the resources required to safely administer it. These resources include the procurement of sedation supplies, monitoring equipment, and, most importantly, personnel. The time a patient spends in the clinic for an examination with sedation is often greater than that for examinations without sedation, not necessarily due to the time of the examination itself, but rather the preparatory and recovery times. Given these costs, thoughtful consideration should be given by an institution as to whether it will utilize sedation. However, we hope that this investigation's findings of decreased potentially preventable diagnostic error will inform these discussions.

Alternative strategies to sedation—In some laboratories, procedural sedation may not be a practical option to achieve patient cooperation. Therefore, discussion of alternative strategies is warranted. Videotape viewing has been shown to achieve patient cooperation in 92% of a small series of children with heart disease who would have otherwise required sedation (mean age 18.6 months).¹⁹ In our laboratory, video viewing is routinely employed for all patients, regardless of their ability to cooperate with the examination.

Risk/Benefit of sedation—In this investigation we have provided evidence for the benefit of sedation in the form of reduced diagnostic error and increased study

completeness. Another potential benefit is the reduction of repeat diagnostic tests due to an inadequate echocardiogram. Analogous situations may potentially be found in non-pediatric/congenital imaging centers, in which optimizing a clinical process may lead to better outcomes through improved diagnostic accuracy. These benefits must always be considered in light of the risks and costs of sedation. Future investigations into the cost-effectiveness of sedation are warranted.

Limitations

This was a retrospective study of patients undergoing sedation and not a randomized trial. Consequently, use of sedation was subject to practice variations. This resulted in significant differences in patient characteristics between the sedated and non-sedated groups. We were able to control for these differences, however, when determining the impact of sedation on possibly preventable error. While we were able to describe the differences between the sedated and non-sedated groups, we were not able to determine specifically why providers chose to sedate their patients; or, when given a similar patient, why one provider chose to sedate when another did not. Additionally, the threshold for what constitutes a diagnostic error is subjective and could be lowered in an investigation that specifically seeks to identify such error. However, our diagnostic error rate was in keeping with other investigations.

CONCLUSION

Diagnostic errors are important clinical events that place patients at risk for injury. The largest fraction of echocardiographic diagnostic errors among infants and toddlers are potentially preventable. Echocardiography with sedation is associated with a reduction of these errors. Pediatric heart centers may consider the use of procedural sedation as a strategy to improve diagnostic accuracy.

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Figure. Anatomic Complexity Case Mix of Echocardiograms

The non-sedated patients had more lesions of low anatomic complexity (81% vs 48%) than the sedated group. Sedated patients had higher rates of moderate (46% vs 18%) and high (7% vs 2%) anatomic complexity than the non-sedated group ($P<0.001$ for all).

Table 1

Classification of diagnostic errors

	Definition	Example
Potentially preventable	Diagnosis could have been made by a more complete examination or different imaging technique	Improper alignment of continuous wave Doppler interrogation underestimates true aortic stenosis gradient
Preventable	Diagnosis is readily apparent on study images but the diagnosis is not made	Pericardial effusion clearly demonstrated, yet diagnosis of "no pericardial effusion" is made
Non-preventable	Echocardiography could not be expected to establish the correct anatomic diagnosis	Failure to image a ligamentum arteriosum completing a vascular ring

Table 2

Univariate comparison of patients undergoing echocardiography with and without sedation

	Total (n = 2003)	Sedation (n = 498)	No Sedation (n = 1505)	P Value
Sex				0.26
Male	1020 (51%)	265 (53%)	755 (50%)	
Female	983 (49%)	233 (47%)	750 (50%)	
Age (months)				<0.001
<6	832 (42%)	110 (22%)	722 (48%)	
6 to <12	292 (15%)	126 (25%)	166 (11%)	
12 to <24	415 (21%)	202 (41%)	213 (14%)	
24 to 36	464 (23%)	60 (12%)	404 (27%)	
Weight (kg, n = 1982)				<0.001
<5	506 (26%)	42 (9%)	464 (31%)	
5 to <10	788 (40%)	288 (58%)	500 (34%)	
10	689 (35%)	165 (33%)	524 (35%)	
Location of Testing				<0.001
Main Clinic	1414 (71%)	416 (84%)	998 (66%)	
Satellite Clinic	475 (24%)	7 (1%)	468 (31%)	
Recovery Room	34 (2%)	34 (7%)	0 (0%)	
Pre-cardiac	80 (4%)	41 (8%)	39 (3%)	
Procedure				
Heart Disease Present				<0.001
Yes	1109 (55%)	374 (75%)	735 (49%)	
No	894 (45%)	124 (25%)	770 (51%)	
Anatomic Frequency				<0.001
Frequent	1441 (72%)	241 (48%)	1200 (80%)	
Less Frequent	392 (20%)	179 (36%)	213 (14%)	
Rare	151 (8%)	70 (14%)	81 (5%)	
Very Rare	19 (1%)	8 (2%)	11 (1%)	

Table 3

Univariate comparison of patients with and without potentially preventable diagnostic errors

	Potentially Preventable Errors (n = 86)	Comparison ^a (n = 1917)	P Value
Age (months)			0.08
<6	34 (40%)	798 (42%)	
6 to <12	6 (7%)	286 (15%)	
12 to <24	19 (22%)	396 (21%)	
24 to 36	27 (31%)	437 (23%)	
Location of Testing			0.01
Main Clinic	57 (66%)	1357 (71%)	
Satellite Clinic	17 (20%)	458 (24%)	
Recovery Room	2 (2%)	32 (2%)	
Pre-cardiac Procedure	10 (12%)	70 (4%)	
Heart Disease Present			<0.001
Yes	70 (81%)	1039 (54%)	
No	16 (19%)	878 (46%)	
Anatomic Complexity			<0.001
Low	31 (36%)	1419 (74%)	
Moderate	45 (52%)	450 (23%)	
High	10 (12%)	48 (3%)	
Anatomic Frequency			<0.001
Frequent	35 (41%)	1406 (73%)	
Less Frequent	33 (38%)	359 (19%)	
Rare	13 (15%)	138 (7%)	
Very Rare	5 (6%)	14 (1%)	

^aComparison group consists of all cases without potentially preventable diagnostic error

Table 4

Multivariable analysis of risk factors for having a potentially preventable diagnostic error and the impact of sedation

	Odds Ratio	95% Confidence Interval	P Value
Heart Disease Present	1.86	0.98, 3.54	0.06
Anatomic complexity			
Low	1.00	--	--
Moderate	3.91	2.25, 6.81	<0.001
High	8.36	3.57, 19.6	<0.001
Pre-cardiac Procedure	2.19	1.05, 4.59	0.04
Sedation	0.47	0.27, 0.80	0.006